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Will privacy concerns associated with future transport systems restrict the public's freedom of movement?

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Abstract

The creation of wide-area real-time monitoring systems for the road network has the potential to achieve a step change in both, our understanding of the evolution of congestion and forecasting / information to minimise its economic consequences. While such comprehensive monitoring systems provide unprecedented levels of information about the network as a whole, they also potentially provide substantial information about individual vehicles and individual travellers. There is therefore the potential that fears about the potential loss of personal information will result in members of the public travelling with less freedom, as they become worried about the future consequences for movements they make in the present. This paper examines the methodology and results of a mail survey conducted in the UK. This survey seeks to ascertain whether in the eyes of the public the potential benefits of future transport systems will outweigh the loss of personal information. The results of the survey support the fears that the advent of some future ITS applications will cause some people to travel with less freedom. It also highlights several key groups that are the most likely to reject future ITS, with contributing factors being elderly, poorly educated, female, from an ethnic minority group and/or having little experience of using the latest transport technologies.

Keywords: Privacy Concerns, Intelligent Transport Systems, Information Privacy, Privacy

1. Introduction

Intelligent Transport Systems (ITS) have the potential to increase the road network capacity, reduce congestion and pollution, create shorter and more predictable journey times and significantly improve the safety of road users. However, on the downside ITS also have the ability to track a citizen's every move, extracting information about their daily lives. This data could range from information about the users

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driving style, exactly where their vehicle was at any given time in its lifetime, right down to the radio station the driver listens to. To make matters worse for the user, this information could be disclosed and used in ways unknown to them (Wright 1995). It has been argued (Daly 2010, Rieman 1995 and Glancy 2004) that privacy invasions caused by ITS will have a damaging effect on society as a whole, therefore creating a 'Big Brother', or panopticon state.

This paper sets out to examine the results of a mail survey conducted in the UK. This survey primarily sought to ascertain whether in the eyes of the public the potential benefits of future transport systems will outweigh the loss of personal information. The survey does this by investigating how participants' would act when faced with a variety of different privacy scenarios. The results of the survey have shown that without significant consideration during the development stage future ITS will cause some people to travel with less freedom, to the detriment of society as a whole. The survey results highlight several key groups who are most likely to reject future ITS because of privacy concerns.

2. Background

There has been a growing argument from privacy advocates, academics and the media that privacy invasions associated with ITS will have a negative impact on society as a whole. Eamon Daly states in his paper, *Personal Autonomy in the Travel Panopticon* (Daly 2010):

'The development and convergence of information and communication technologies (ICT) is creating a global network of surveillance capabilities which affect the traveller. These surveillance capabilities are reminiscent of 18th century philosopher Jeremy Bentham's panopitcon, and as such the emerging global surveillance network has been referred to as the travel panopticon. I argue that the travel panopticon is corrosive of personal autonomy…'

The panopticon is a type of prison building, designed by English philosopher and social theorist, Jeremy Bentham, in 1785. The concept of the design allows a person to observe all prisoners, without the prisoners being able to tell whether they are being watched, (Bentham 1995). The major effect of the panopticon is to induce in the prisoner a state of conscious and permanent visibility that assures the automatic function of power. (Foucault 1979). French philosopher, Michel Foucault, then developed Bentham's theory, describing how the panopticon would work, even when no observer was present. Due to this, he used the panopticon as a metaphor for how the modern world can be used for social control. Former US vice president, Hubert Humphrey, summarised the panopticon effect (Reiman 1995) :

'If we can never be sure whether or not we are being watched and listened to, all our actions will be altered and our very character will change.'

J. Rieman describes in his paper, *Driving to the Panopticon* (Rieman 1995) that the problem with ITS is that it not only ensures that people are seen, it makes them feel visible. He feels that the consequence of this is that individuals will alter their behaviour, and this will impact society as a whole. He links to a future world as portrayed in the science-fiction film, Demolition Man, where constant enforcement of totalitarian laws leads to individuals becoming more childlike and exempt of freedom of expression. Others (Guardian 2009 and Buhrman 2007) have related the use of ITS to the creation of an Orwellian surveillance society. Glancy suggests that not only does ITS allow for a 'Big Brother' in the form of an omnipresent totalitarian government, but also a whole host of 'Little Brothers' in the form of private-sector information collectors, some of whom may have little respect for individual privacy (Glancy 2004).

For these fears to be fulfilled, it needs to be the case that citizens are not only concerned about the privacy impacts of ITS, but that the ITS will actually cause citizens to change their travel behaviour. Conversely for these fears to be unjust it needs to be proven that future ITS will not cause citizens to stop using their vehicles, or stop travelling with the same freedom that they currently enjoy (Cruickshanks 2011). Therefore it is essential if the benefits of future ITS are to be achieved that users feel that they can travel with the same amount of freedom both before and after the ITS is implemented.

Despite the importance of this topic however, there exists only a small amount of previous research specifically considering the privacy concerns associated with transport systems. These include a survey conducted as part of the CVIS project (CVIS 2007) and a survey looking into the fairness of road pricing (Jakobsson et al. 2000). Neither of these surveys however directly addressed whether users would actually change their travel behaviour if the systems where implemented. A significant amount of studies however have been made into privacy concerns in other fields. Most notably, between 1978 and 2004, Alan Westin carried out over 30 privacy-related surveys (Westin 2003) covering general privacy, consumer privacy, medical privacy, and other privacy-related areas. The common interest in the majority of these surveys (Kumugara 2005) is that they use what Westin calls his General Privacy Concern Index, which categorises a person's views on privacy into one of three groups:

- **The Fundamentalists** are generally distrustful of organisations that ask for their personal information and are in favour of new laws and regulatory action to spell out privacy rights and provide enforceable remedies. Fundamentalists generally choose privacy controls over consumer-service benefits when these compete with each other.
- **The Pragmatics** weigh the benefits of various consumer opportunities and services against their privacy concerns. They believe that organisations or governments should 'earn' the public's trust rather than assume automatically that they have it. Most importantly, they want the right to opt-out of giving away their personal information.
- **The Unconcerned** are generally trustful of organisations collecting their personal information and are ready to forego privacy claims to secure benefits. They are not in favour of the enactment of new privacy laws and regulations (Kumaraguru 2005).

The persistency of these three groups across various issues suggests that equivalent viewpoints should exist when considering attitudes towards ITS.

Other relevant surveys include the 2007 Community Attitudes Towards Privacy Study which was commissioned by the Office of the Privacy Commissioner, Australia (Wallis 2007). This survey showed that people's privacy concerns generally increase with age and education level and additionally that certain privacy concerns have their own specific demographic influences; for example, people living in urban areas have more trust in retailers and young people are more concerned about giving away their home phone numbers and address (which is against the previous evidence that young people are less concerned about privacy issues). The majority of the results gained in this survey are supported by another study conducted in America (Phelps et al. 2000). However, Phelps disagreed with the fact that people's overall privacy concerns increase with education level; suggesting instead the opposite. Finally, a survey conducted by The Pew Internet and American Life Project into trust and privacy online (Fox et al. 2000) looked at how people's privacy perceptions varied, according to demographics and internet experience. This study confirms the age bias indicated in the Wallis (2007) survey. It also goes on to show that in the US ethnic minorities are likely to have increased privacy concerns, as are females over males, although it also identifies that privacy fears associated with internet use decrease significantly with user experience.

Although some people might have privacy concerns about future ITS however, this does not necessarily guarantee that their actual behaviour will reflect these concerns (Wardman 1988). The most relevant pieces of research investigating how privacy attitudes may relate to actual behaviour revolve around the field of ecommerce. Berendt, Günther and Spiekermann (2004) conducted a large scale online shopping experiment, which looked into whether a user's stated preference was reflected in their actual behaviour. The experiment began by using a questionnaire to measure the user's level of privacy concern, followed by a virtual shopping trip, buying cameras and jackets with their own money. While shopping the user was given 'assistance' from an online agent who asked questions and made recommendations. The role of the agent was to ask the user up to 56 optional questions, where the goal was see if the user kept to the preferences they stated in the privacy concern questionnaire. The experiment, as expected, found that the amount of information disclosed increased from privacy fundamentalists to marginally concerned users. However, the headline result of the experiment was that the absolute level of disclosure was high across all privacy groups, belying the users initially expressed reluctance to disclose their personal data online. This potential discrepancy between stated concerns and revealed behaviour has been confirmed by other studies (Hann et al 2002, Cvrek et al 2006, Varian et al 2005), all reaching similar conclusions that actual behaviour is directly linked to the level of privacy concern, but to a lesser extent than the participants believe.

In summary therefore, privacy related research from other fields suggests that future travellers will fall into three groups (unconcerned, pragmatists and fundamentalists), with levels of privacy concern possibly increasing with increasing age and/or education level and being higher for females and/or ethnic minorities. High levels of concern are also expected to impact on behaviour, with privacy concerns associated with future transport systems therefore having the potential to restrict the public's freedom of movement, but it is important to clearly establish both concern and behaviour when establishing the privacy implications of future ITS.

3. Survey Methodology

To establish whether the expected privacy concerns and behavioural impacts apply equivalently to ITS applications, a questionnaire survey was undertaken in the UK. The questionnaire was distributed through the mail to a random sample of the Metropolitan Borough of Sefton, which analysis of the UK 2001 census results showed to be the district in the UK whose demographic makeup most closely reflected that of the wider population.

In the UK, two electoral registers are created for each district, a full register (containing the names and addresses of all eligible voters) and an edited register containing the names and addresses of all those who do not specifically 'opt-out' of being included. While the full register remains with the local authority the edited register is available to purchase by companies. Half of the surveys sent out were sent to people selected randomly from the edited electoral register for Sefton, but as those people who have opted out of being on the edited register are likely to have different privacy views from those who have not opted out register, the remainder of the questionnaires were sent to addresses that did not appear on the electoral register (addressed simply to the 'homeowner' as their name was unknown).

The part of the questionnaire considered in this paper is ten binary privacy scenario questions (which can be seen in full in Appendix A). These scenarios measure the participants stated privacy preferences in a variety of situations. Three types of scenarios were used; scenarios relating to future transport technologies, scenarios relating to general privacy concerns and scenarios which can be used to test the link between the participants stated preference and their actual behaviour.

In addition to the scenario questions, several other questions were also incorporated, including a series of questions that measured the respondent's current privacy behavior and a question to see whether the participant would be willing to disclose some personal information in return for the chance to earn £20 worth of gift vouchers

4. Results and Discussion

In total 195 useful responses were returned, 49% of the responses came from people who had decided to opt out of having their details on the edited electoral register. The average age of the sample was 53.5 years (SD 16.1 years), with 49% of the sample being female.

Hierarchal cluster analysis was run on the answers to the ten privacy scenarios to identify groupings of similar concerns and actual behaviours. From interrogating the resulting dendrogram it became apparent that there were four distinct clusters; The Fundamentalists, The Pragmatics and The Unconcerned groups as expected from previous research, but also a group of The Commuters. (Table 1 shows the summary distribution between the four clusters, a full breakdown of the results can be seen in Appendix A).

The most notable result is that the cluster analysis identified four distinct groups of people's privacy views. It was predicted that there would be three distinct groups The Unconcerned, The Pragmatics and The Fundamentalists. The breakdown of the number of 'yes' answers for each cluster suggests that these three clusters are present but that there is also a small additional cluster The Commuters. Analysis of The Commuters cluster shows that a relatively focused group of people share a distinct privacy view. The Commuters cluster is made up predominately of males between the age of 36 to 66 who are likely to have a higher than average household income but uniquely a lower than average education level. The Commuters cluster also has the highest percentage of people currently in employment compared to the other three clusters.

Table 1. Cluster Distribution

Cluster	Percentage of Sample	Average Number of Acceptable Scenarios
Fundamentalists	21.5%	2.67
Pragmatics	33.3%	3.85
Unconcerned	32.3%	7.52
Commuters	12.8%	5.80

The distinct thing about the privacy views of The Commuters cluster (shown in Appendix A) is that for the general privacy and test scenarios they exhibit incredibly high levels of concern. However, for the future ITS scenarios they exhibit very low levels of privacy concern. The most likely reasoning behind this is that this cluster spends a significant proportion of their lives travelling for their jobs so anything that improves their journeys would be highly valued. In addition to this a couple of ecommerce surveys (Lohse 2000, Wallis 2007) have shown that regular internet users have lower privacy concerns relating to internet use, so it is highly likely that the same is true for people who regularly use existing transport technologies.

It was expected that privacy concerns would increase with age and possibly education level. With the exception of The Commuters cluster, the results of this study (Table 2) show that The Fundamentalist cluster had the highest level of people aged over 55 years (55%) and The Unconcerned cluster had the lowest proportion of people aged over 55 years (38%). With education level the results suggest that

privacy concern may actually decrease with increasing education level (with The Fundamentalists having the lowest percentage of highly educated people - 30%), matching the result reported in a survey conducted by Phelps, Nowak and Ferrel (2000).

Table 2. Demographic Breakdown of the Clusters

Cluster	Gender (Males)	Age (Over 55)	Ethnicity (White British)	Income (£0-20k)	Education (Level 4+)	Employment Status (Employed)
Fundamentalists	43%	55%	88%	50%	30%	41%
Pragmatics	46%	49%	89%	39%	44%	46%
Unconcerned	55%	38%	95%	30%	43%	52%
Commuters	64%	59%	92%	29%	33%	56%

Finally, privacy concerns were expected to be higher if the user was female and/or from an ethnic minority group. Both of these factors are supported by the survey results (Table 2), with The Fundamentalist cluster having the highest number of males (57%) and respondents from ethnic minorities (12%). While (excluding The Commuters cluster) The Unconcerned cluster has the lowest percentage of males (45%) and respondents from ethnic minorities (5%).

Table 3. Actual Privacy Behaviour of the Clusters

Cluster	Electoral Register (Opted Out)	Disclosed Info (Yes)	Ex Directory (Yes)	Credit Check (Yes)	Internet Shopping (Yes)	Loyalty Card (Yes)
Fundamentalists	67%	19%	48%	26%	57%	81%
Pragmatics	48%	31%	42%	32%	74%	89%
Unconcerned	35%	46%	45%	18%	77%	82%
Commuters	56%	52%	48%	24%	76%	84%

Considering the expected relationship between concern and actual behaviour when faced with a privacy scenario, Table 3 clearly indicates that the results of this study support the existence of a positive relationship. The Fundamentalist cluster contained the most people who opted out of being on the edited electoral register (67%), the fewest people who were willing to give away further contact details in return for the chance to receive £20 worth of gift vouchers (19%) and the most people whose telephone number is ex-directory (48%). The opposite is true for The Unconcerned cluster.

Table 4. Comparison of the scenario answer to reality for the whole sample

'Yes' Answer Given	Loyalty Cards	Internet Shopping	Airport Security
Scenario	15%	53%	91%
Reality	85%	71%	99%

It is also clear however that not everyone acts on their privacy concerns. To test this three of the scenario questions asked real life scenarios (see Appendix A) and the answers to these questions were compared to the participants real life behaviour. Table 4 shows that for each of the scenarios the number

of people who stated they would carry out an action is in reality considerably lower than those who actually carry out the action in real life. This is particularly true for the store loyalty card (where ecommerce research suggests that a significant number of the sample may not realise that in using their store loyalty card they are directly trading information about their purchase history for a small financial gain).

5. Conclusions

From this study it has been possible to conclude that there are justifiably significant fears that the advent of some future ITS applications will cause some people to travel with less freedom, to the detriment of society mobility as a whole. This study has highlighted several key groups who are the most likely to reject future ITS and travel with less freedom as a result, with contributing factors being elderly, poorly educated, female, from an ethnic minority group and/or having little experience of using the latest transport technologies. With regards to future ITS systems these findings suggest that while some people will be willing to trade their personal information for improvements to the transport network (The Commuters and The Unconcerned) there is a significant percentage (~55%) of the population who will express concerns (The Fundamentalists and The Pragmatics). This study has shown that it is unlikely that all of those who express privacy concerns will actually act upon then. However, it does indicate that unless privacy issues are taken into account during the development stage of future ITS these systems will cause some people to travel with less freedom, fulfilling the fears highlighted earlier in this paper. This is further highlighted by the fact that 44% of the survey sample stated that if their whereabouts was made public at all times they would stop travelling to certain places.

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Appendix A. Questionnaire Design and Results

Scenario Instruments

Type of Scenario	Scenario	Question	Total Sample 'Yes' Answers	Fundamentalist 'Yes' Answers	Pragmatics 'Yes' Answers	Unconcerned 'Yes' Answers	Commuters 'Yes' Answers
ITS	B	During a car journey would you tell a company the road and weather conditions in your location via a wireless network if it would help to reduce your impact on the environment?	70%	67%	45%	87%	100%
ITS	F	Would you tell the government by text message exactly where you plan to travel if it reduced your travel time?	47%	2%	28%	86%	72%
ITS	G	During a car journey would you tell a stranger your location over a wireless network if it improved the safety of you and your family during the journey?	61%	43%	23%	95%	100%
ITS	I	Would you let a private company know about your driving behaviour (speed at which you travel, how far you travel etc) if it reduced your insurance premiums?	77%	40%	78%	92%	100%
General	D	Would you tell a close friend your embarrassing secrets in a letter sent by postal mail if you thought it would bring you a lot of enjoyment?	17%	12%	8%	37%	4%
General	E	Would you tell a journalist in a private meeting your musical preferences in return for a rise in your social standing?	30%	0%	18%	73%	0%
General	J	Would you tell your medical conditions to a random doctor via a mobile phone if you thought it could improve your health?	42%	21%	15%	84%	36%
Test	A	Would you give the details of everything that you purchase to a private company by email in return for a financial gain?	15%	0%	11%	37%	0%
Test	C	Would you send your credit card details over an internet connection to a private company to book a room at a hotel in order to receive a discount?	53%	0%	68%	68%	68%
Test	H	Would you allow a security guard to search you and your luggage if it might improve your safety?	91%	81%	91%	94%	100%

Other Instruments

Question	Total Sample 'Yes' Answers	Fundamentalist 'Yes' Answers	Pragmatics 'Yes' Answers	Unconcerned 'Yes' Answers	Commuters 'Yes' Answers
Do you use loyalty cards (Nectar Card, Tesco Club Card, Air Miles Card etc.)	85%	81%	89%	82%	84%
Have you ever purchased anything with a credit card on the internet?	71%	57%	74%	77%	76%
Have you been through / Would you be willing to go through airport security?	99%	98%	100%	100%	100%
Is your telephone number listed as being ex-directory?	45%	48%	42%	45%	48%
Have you ever checked the data, credit checking agencies (Experian etc) hold on you?	26%	26%	32%	18%	24%
Do you fully understand what your legal rights with regards to privacy are?	10%	21%	11%	6%	4%
Would they disclosure person information for the chance to earn £20 worth of gift vouchers?	37%	19%	31%	46%	52%
Have they opted out of the edited electoral register?	49%	67%	48%	35%	56%

Demographic Questions

		Total Sample	Fundamentalist	Pragmatics	Unconcerned	Commuters
Gender	Male	51%	43%	46%	55%	64%
Age	16-25	9%	14%	14%	13%	0%
	26-35	5%	5%	9%	6%	0%
	36-45	11%	17%	9%	19%	5%
	46-55	23%	10%	18%	24%	36%
	56-65	27%	21%	18%	25%	41%
	66-75	16%	19%	20%	10%	14%
	75+	9%	14%	11%	3%	5%
Children	Yes	78%	79%	74%	81%	80%
Marital Status	Married	61%	65%	60%	56%	63%
Ethnicity	White British	91%	88%	89%	95%	92%
Education Level	None	15%	13%	13%	10%	21%
	Level 1-3	48%	58%	44%	48%	46%
	Level 4+	37%	30%	44%	43%	33%
Household Income	£0-20k	37%	50%	39%	30%	29%
	£20-40k	38%	22%	43%	39%	43%
	£40-60k	12%	16%	6%	18%	14%
	£60-80k	7%	9%	7%	9%	5%
	£80k+	6%	3%	6%	5%	10%